

**GOVERNMENT OF INDIA
BHABHA ATOMIC RESEARCH CENTRE
REACTOR ENGINEERING DIVISION**

MF-(Enquiry)

Hall.No.7
Trombay
Mumbai 400 085

Ref: RED/ARIES/VMS/ MF/2017/ 197850

Nov 9 , 2017

Dear Sir,

Sealed quotations are invited by Head, RED, BARC, for the minor fabrication jobs as per the following requirements


Sub: Supply, installation, fabrication, commissioning of Instrumentation and control system related to WASIF facility Phase – I as per Annexure-I at SRI, AERB, Kalpakkam. The work broadly involves are as follows;

Supply, fabrication, installation of Instrumentation and accessories such as DPTs, TTs, Flowmeters, Controllers, cables & Tube fittings, etc., wiring of panel, Cabling from field to control panel, internal terminations, signal loop checking, testing and commissioning of the system as per Annexure-I for WASIF - I facility at SRI, AERB, Kalpakkam. The scope of supply also includes preparation of wiring connection diagrams, cable layout diagrams, JB Terminal wiring diagrams, panel wiring diagrams and any other drawing as and when required.

1. Sealed quotations are invited by Head, RED for Tender Enquiry for **“Supply, installation, fabrication, commissioning of Instrumentation and control system related to WASIF facility Phase – I at SRI, AERB, Kalpakkam”**
2. The quotations must reach Head, RED, Engg. Hall No. 7, BARC, Trombay, Mumbai- 400 085 on or before **28.11.2017**. The envelope should be super scribed "Minor Fabrication- WASIF, Kalpakkam" and indicate the DUE DATE and Office Ref. No. clearly. The envelope should be sealed and sent through SPEED POST OR REGISTERED POST.
3. The envelope should be super scribed "MINOR FABRICATION" and indicate this office reference no. & due date of opening clearly.
4. The necessary items as given in the enclosed technical specifications will be provided by the supplier.
Bidder shall quote, the item wise cost of each of the works described in the Annexure-I. The general terms and conditions are also given in the Annexure-I. The bidder shall submit a list of material required including the quantity and applicable GST. **The bidder shall submit complete information asked in the enquiry, otherwise the quotation will not be accepted.** The quotation shall be on proper letter head mentioning complete address, Phone numbers, fax number, PAN number/ GST registration, etc. Without these details quotation will be liable for rejection.
5. The quotation will be opened on **29.11.2017 at 14.00 Hrs.**

6. **In case the bidder needs to clarify and understand the full scope of work before submitting the quotation, he may do so by prior appointment with Shri V. M. Shanware, SO/G, Engg. Hall No. 7, BARC, Trombay, Mumbai- 400 085 on phone no. 25591609/25596916/25593550.**
7. Work should be completed within 90 working days from the date of receipt of the order.
8. The price quoted should be valid for at least 90 days from the date of opening of the quotation.
9. The work is linked with the commissioning and experimental schedules of the **WASIF, SRI, Kalpakkam**, which is to be strictly adhered in view of the importance of the project. The contractor shall ensure to be timely present at the site as and when required.
10. A brief list of similar jobs executed earlier if any and the name of the organization for which the work was carried out should be furnished with the quotation.
11. Pro-rata payment i.e., splitting of order is not acceptable.
12. Free issue of Material will be provided as per Table 3 in Annexure I.
13. Payment will be made as per Government Rules after successful and satisfactory completion of the job.
14. The minor fabrication work will be subject to inspection/supervision by the indenting officer or his authorized representative.
15. The bidder shall specify that "whether he/she has any relation in BARC or the bidder himself is an ex-employee of BARC or the bidder has an ex-employee of DAE on his payrolls", if any, the supplier shall indicate full details of the concerned person in their quotation.
16. The Vendor should strictly follow "confidentiality clause" as per Annexure-II.
17. Head, Reactor Engineering Division reserves the right to accept/reject any or all of the quotations received without assigning any reason whatsoever.
18. Contractor shall appoint the required workers with high integrity and will be responsible for his workers. All BARC/IGCAR/AERB security rules will be applicable. Supplier must dispose off all the debris after completions of the job. Entry permit will be issued on monthly basis and contractor must have valid photo pass up to March, 2018.

Encl:- Annexure-I, Annexure-II


(Dr. D N Badodkar)
Head, RED and Director, RD&DG
डॉ. डी. एन. बडोदकर
Dr. D. N. Badodkar
निदेशक, रिक्टर अभिकल्पन एवं विकास वर्ग
Director, Reactor Design & Development Group

08	DC supply distribution box with switch, fuse and indicator for each connection (12 points)	Nos.	02	
09	24 V DC Relays with 2 NO and 2 NC contacts, contact rating of 230 VAC, 1 Amps (alongwith the relay rack for mounting)	Nos	12	
10	Ready to use Thyristor based Heater control panel for 5 KW heater.	Nos.	04	Specification given in section B
11	100 Terminal Field Junction Boxes (size:400mmx 400mmx 175mm)	Nos.	02	Specification given in section B
12	TT Box with transparent front acrylic plate (size:500mm x 400mm x 175mm)	Nos.	01	
13	Pre-galvanized perforated Cable trays (with suitable cover and perforated bottom). Size, height 50mm, thick 1.5mm and width 300mm.	Meters	100	
14	Pre-galvanized perforated Cable trays (with suitable cover and perforated bottom). Size, height 50mm, thick 1.5mm and width 100mm.	Meters	100	
15	1.5 Sq. mm single core cable for panel wiring.	mtrs	500	
16	2-core cable for field instruments	mtrs	1000	Specification given in section B
17	K-type thermocouple extension cable	mtrs	1000	Specification given in section B
18	37-core multi-core signal cable	mtrs	500	Specification given in section B
19	PVC Cable conduit 1 “ size	mtrs	500	
20	PVC end connectors for conduit	Nos.	500	
21	SS 316 Double Ferrule compression type Tube Fittings/Adaptors as follows:			Specification given in section B
	a. Adaptors ½ “ inch NPT (M) to ¼ “ NPT (F) make: Wintech or equivalent	nos.	20	To withstand high pressure (250 bar) and high temperature(200 deg C).
	b. Adaptors ½ “ inch NPT (M) to ¼ “ NPT (F) make: Wintech or equivalent	nos.	10	
	c. Connectors for adaptor ¼ “ NPT (M) to M10X1 UNF (F)	nos.	10	
	d. Adaptors ½ “ inch NPT (M) to ¼ “ NPT (F) make: Wintech or equivalent	nos.	50	
	e. Adaptor ¼ “ NPT (M) to M8 (F) suitable for M8X1 (M) connector	nos.	25	
	f. Adaptors ¼ “ inch NPT (M) 1.1 mm ID tube (for brazing): Wintech or equivalent	nos.	25	
	g. Adaptors ½ “ inch NPT (M) to 3/8 “ OD Tube: Wintech or equivalent	nos.	20	
22	SS304L(seamless) Tube (3/8” OD, thickness 0.065”) for pressure rating #5600, Ovality ≤ 5%	Mtrs.	200	
23	SS316 Wet Leg Pot	Nos.	3	Specification given in section B
24	Tag plates for various field and panel components	Nos.	200	

Table 2: Installation and Commissioning:

Sl. No.	Description	Unit	QTY.	Remarks
01.	Installation of thermocouples	Nos	25	
02	Installation of Temperature Transmitters	Nos	25	
03	Installation of Pressure Transducers	Nos	15	

04	Installation of Pressure Gauges	Nos	1	
05	Installation of Strain Gauges	Nos	03	
06	Installation of Accelerometers with electronics	Nos	1	
07	Installation of Level transmitters(with condensate pot)	Nos.	3	
08	Installation of Flow meter with transmitters	Nos.	2	
09	SS Tubing including with swaging	Mtrs	200	
10	Installation of PID Controller with heater control interface to electrical supply.	No.	4	
11	Installation of PID Controller with flow control interface to control valve.	No.	5	
12	Installation of DC Regulated Power Supply	No.	2	
13	Installation of Relays relay	Nos.	1	
14	Installation of cable trays	meters	200	
15	Installation of Junction Boxes	Nos.	03	
16	Laying of 2-core signal cable	meters	500	
17	Laying of Thermocouple extension cable	meters	500	
18	Laying of multi-core (37-core) signal cable	meters	200	
19	Installation of DP Transmitter	Nos.	3	
20	Panel wiring Termination	Nos.	1000	
21	Signal loop checking	Nos.	50	
22	MS work for fabrication	kgs.	200	

2. The scope of supply also includes wiring connection diagrams, preparation of cable layout diagrams, JB Terminal wiring diagrams, panel wiring diagrams and any other drawing as and when required.

B. TECHNICAL REQUIREMENT

1. Specifications of DP Transmitter for Level

These Smart electronic differential pressure transmitters shall be two-wire, smart type having good accuracy and advanced communication features. Each transmitter shall be supplied with integral LCD display, mounting accessories, integral three-valve manifold and operation & maintenance manual.

Functional specifications

Process fluid : Water/Steam
 Calibration range : as per Table-A
 Over range limit : 1.5 times the maximum range.
 Turndown ratio : 100: 1.
 Output : Two wire 4 - 20 mA DC; with digital signal superimposed on 4 – 20 mA signal.
 Digital communication : HART
 Power supply : 24 V DC with maximum load of 600 ohms.
 Output current limit : Over scale ≥ 20.5 mA
 Under scale ≤ 3.8 mA
 Span and zero : Span and zero shall be continuously adjustable. Zero elevation /suppression shall be -100% to $+100\%$ of URL.
 Maximum permissible process Temperature : 200 deg.C
 Damping : 0.2 sec. or better, adjustable damping, bidder to specify the range.
 Built-in display : 5 digit LCD meter with user definable display modes.

Performance specifications

Accuracy : $\pm 0.075\%$ of span (including linearity , hysteresis and repeatability) . This shall be applicable for calibrated span $\geq 1/10$ of URL.

Stability : +/- 0.1 % of upper Range Limit (URL) over a period of 36 months.
 Static pressure effect : Zero shift- +/- 0.1% of URL / 100 bar.
 Over range effect : Zero shift - ≤ +/- 0.1% of URL per 100 bar.
 Mounting effect :For +/- 10 degree tilt from a reference position of transmitter should not cause noticeable change in output.
 Power supply effect : Less than +/- 0.005% per volt of the calibrated span.
 Ambient temperature effect : 0.02% of span / deg.C (includes both zero and span error)
 Response Time : 90msec

Ambient Conditions

Ambient temperature : 60 deg.C maximum.
 Humidity : Upto 95% RH

Physical specifications

Materials of construction & Sensing diaphragm: Stainless Steel 316
 Electronics housing: Die cast Aluminum.
 Environmental protection: IP 67
 Mounting accessories: Required for 50 mm NB horizontal pipe mounting.
 Integral three valve manifold: Required (made of Stainless Steel 316) with 1/2” NPT (F) process connection

TABLE-A

S.No	Range	Qty
1	0-300mm of WC	2 nos.
2	0-1300mm of WC	1 no.

2. Specifications of Temperature transmitters

Signal type : Analog input
 Rated voltage : 12 - 35 V DC loop powered
 Power dissipation : 0.4 W
 Connection side : Field side
 Connection : thermocouples type E, J, K, N, R, S or T cold junction referenced to 0 °C (32 °F)
 Lead resistance : ≤ 100 Ω per line
 Current output : 4-20 mA, limited to ≤ 35 mA
 Fault signal : downscaling ≤ 3 mA , upscaling ≥ 22 mA
 Measurement range : span 4-100 mV, zero point -12-60 mV, both adjustable
 Deviation : 0.1 % of full-scale value ± 1 K for the cold junction
 Temperature Deviation : ≤ 1.5 μV/K
 Influence of supply voltage : 6.5 ppm/V
 Rise time : 250 ms
 Galvanic isolation : safe isolation according to EN 50178, rated insulation voltage 253 Veff
 Electromagnetic compatibility : NE 21
 Ambient temperature : -20-60 °C

3. Specifications of Vortex flow meter

General: Flow measurement of liquids, gases and vapors
Measured Value: Operating and standard / normalized volumetric flow, mass flow
Measuring Accuracy: ± 1% of actual flow

Measuring Sensor: Flange version (with integrated temperature measurement)

Product Conditions:

Ambient temperature : -40°C (-40°F) to +85°C (+185°F)

Fluid temperature : -40°C (-40°F) to +240°C (+464°F)

Process products: Liquids, Gases, Vapors

Product pressure limit: Max. 100 bar, at atmospheric conditions

Materials:

Sensor, wetted parts and process connections : SS 316L

Electronics housing: Die cast aluminium

Pressure sensor gasket: FPM

Measuring tube gasket: SS 316L

Electrical Connections:

Power supply range: 14 VDC to 36 VDC

Protection category : IP 66/67

Current Output:

Measuring range : 4 to 20mA

Over range : 20.8 mA +/- 1%

Load: minimum 100 ohms Maximum $R \geq ((U_b - 14 V) / 22 \text{ mA})$

Maximum : 22.0 mA

Digital Output : HART

Physical layer : FSK

Equipment category: Transmitter

Display: 2 lines, 10 characters LCD

4. Specifications of PID Controller

The electronic PID Controllers are to be used for operating final control element such as an electric heater. The controller shall be suitable for mounting in a chassis and shall be removable from front of the panel by sliding out of chassis. They shall have quick connect type terminations. The chassis, after removal of the controller shall remain in its installed position on the panel and shall be flush mounting type.

Indications Required: 7-segment, 3 1/2 digit (or better), LED indication for following

- a) Measured variable: 0 - 100 %
- b) Set point Value: 0 - 100 %
- c) output: 0 - 100 %

Set point: Shall be adjustable by suitable push button sequence.

Auto/Manual Operation:

Auto/Manual Selection: Through a push button.

Manual Mode: Through "Increase" and "Decrease" push buttons.

Alarms

Independent high and low alarms required.

Set Point: Adjustable throughout the range.

Alarm Output: Through relay with contact rating 1A inductive and at 230 VAC,50Hz.

Relay Status: De-energises when the output crosses set point level and in case when power supply is switched off.

Functional Requirement

Input: 4 - 20 mA DC (with the input maximum series resistance of 250 Ω)

Output: 4 - 20 mA at 800 Ω max.

Control Modes and Adjustments: ON/Off and PID mode with Auto-tuning feature having following settings:

- a) Proportional Band: 2 % to 500 % or better.
- b) Reset Rate: 1 to 200 repeats/minute.
- c) Derivative Time: 0.1 to 20 minutes with off switch.

Controlled action: Direct or reverse control action selected through a selector switch

Performance Specification

Controller accuracy: ± 0.5 % FS or better.

Repeatability: 0.2 % FS or better.
 Dead band: less than ± 0.1 %.
 Alarm setting accuracy: ± 2 % FS or better.
 Temperature effect: less than ± 0.2 % FS per 25°C in ambient temperature.
 Power supply Variation: 240 V AC ± 10 %, at 47 Hz to 52 Hz.

The exact performance details shall be supplied by the bidder.

Miscellaneous

Dimensions: Should be specified by the bidder

Material of construction: All the PCBs shall be of glass-epoxy and shall be lacquered after soldering. The casing shall be baked painted.

Electrical Connection:

All connections shall be Screw type on terminal block suitable for wire size of 1 mm Φ maximum. Insulation resistance between input terminal and body shall be atleast 100 M Ω at 500 VDC.

Ambient Condition: 10°C to 50°C with RH upto 95 %.

Documentation:

One copy each of installation, operation and maintenance manuals with circuit and wiring diagrams and spares list shall be sent along with each controller.

5. Specifications of Annunciation System

Supply Voltage : 90-270 V AC , supply failure feature to be included on separate window.
 Windows : 16 nos.
 Window Sizes : Vendor to quote
 Display Device : Super bright high efficiency low power consuming LED's
 Facia Type : Individual windows Front Replaceable
 Window/LED Colours : RED, Yellow, Green, White & Blue
 Flash Rate : Fast - 60 flashes/min. Slow - 30 flashes/min.
 Response Time : ≤ 40 ms
 Input Signal : Potential free contacts (NO or NC site selectable)
 Grouping : Trip / Non Trip site selectable
 Interrogation Voltage : + 12 V DC
 Output Contacts : 1 NO + 1 NO + 1 NO (optional)
 Architecture : Integrated
 Operational Sequences : Auto Ringback Alarm Sequence and common ring back audible sequence as per ISA 2A, ISA S18.1 –1979 (R 1985) as per the Table-B
 Operational Temp. : 0-60 degrees C
 Power Consumption : 1.5 Watts per Window (Max)
 Optional : AC-DC fail Annunciation or Indication / Repeat Relays / RS232 - 485 Port

TABLE-B
Ring Back Annunciator Sequence

CONDITION	Manual Action	Audio	Visual	Ring Back Alarm
Normal		Off	Off	Off
Abnormal		On	Fast flash	Off
Normal before accept		On	Fast flash	Off
Normal	Accept	Off	Steady	Off
Ab-Normal	Accept	Off	Steady	Off
Normal before reset		Off	Slow flash	On
Normal	Reset	Off	Off	Off
Ab-normal	Reset	Off	Steady	Off
Normal	Test	On	Slow flash	Off

6. Specification for Linear Regulated D.C. Power supply

Input Power supply: 230 V \pm 10 %, single phase, 50 Hz
Output: 24 V DC with 2 nos. of extra supply tapings.
Output Current: 5 Amp DC
Regulation: 0.1 % including input power supply and load variation.
Output Ripple : Better than 50 mV.
Insulation Resistance: 100 Mega ohms 100 V DC.
Mounting: Rack/Wall mounting type

7. Specifications of Band heaters control system with small panel.

Standardized thyristor controller with following specifications:

Power:

Nominal current : 1 to 125 amps
Nominal voltage : 100V to 500V
Accuracy : +2% of full scale
Frequency : 47Hz to 63Hz
Protection : High speed fuses
Type of loads : Resistive or slightly inductive load ($\cos \phi > 0.8$)

Control :

Auxillary power supply : 100V to 500V +10%/–15% or 24 ac/dc ($\pm 20\%$)
Control setpoint : Analogue or logic input or digital comms
Analogue input signal : Current range 0-20 mA or 4-20 mA (DC)
Resolution : 11 bits
Linearity : $\pm 0.1\%$ of Scale
Firing mode : Variable Modulation Burst firing (default 16 cycles), Fix modulation period (default 2 seconds, Logic mode, Phase angle
Control mode : V2 , I2 control, True Power control
One Alarm Relay : Changeover relay 2A rms - 264V rms normally energised.

8. Specifications for the junction box with accessories

The dust proof door type junction boxes shall be made of C.R.C.A. Mild steel of 2mm thickness with grey enameled and baked. The junction boxes shall be provided with good quality door hinges and hand knobs. The cable entry shall be from bottom and top sides.

The field-JB should be of 400 mm(W) x 400(H) x 175(D) size and should house 100 nos. CET-4 type Elmex or equivalent electrical terminals mounted in 2 rows on suitable rails with end clamps and tags. The door shall be hinged and be provided with suitable locking arrangement.

9. Specifications of Multi core signal cables

Multi core, multi-stranded, flexible with fire retardant (FRLS) PVC insulated compound copper cables are required for Instrumentation and control signal (0-5V & 4-20mA) wiring as follows..

Quantity required

- a) 37 Core Cable, 500 Meters
- b) 2Core Cable, 1000 Meters

Standards to be followed

Except as noted the manufacture, testing and packing of cables covered by this specification shall comply with the following standards:

- (1) IS : 694-1977 : Specification for Multi-core signal cables .
- (2) ASTM –2843 : For smoke test

- (3) ASTM –2863 : For oxygen Index test
(4) Bending radius : to be specified by bidder, not more than 8 times the diameter of cable, as per the above standard.

General requirement:

1. Cables shall be manufactured of such quality that damage will not result from transportation, installation.
2. Cables shall be suitable for laying in conduits, vertical installation, ducts, trenches, trays etc.
3. Cables shall be suitable for contiguous and reliable service at maximum voltage of 600 V and a maximum conductor temperature of 90 °C.
4. Multi core cable shall be PVC insulated, tinned copper braided, melinex taped.

Conductor

Each core shall be of annealed, tinned copper conductors with at least 48 strands of 0.2 mm diameter each over all area of conductors 1.5 Sq. mm) and resistance less than 9 ohm / 100mtr.

Insulation

The insulation shall be fire retardant low smoke (FRLS) PVC compound confirming smoke density rating 60% max as per ASTM –2843 and oxygen index shall not be less than 29. Flammability test confirming (a) min unaffected portion from top to flame > 50 MM (b) maximum period of burning after removal of flame < 60 seconds. The material of inner and outer insulation shall be PVC and minimum thickness of insulation shall not be less than 0.6 mm, the cable shall be flexible.

Insulation resistance

As per ANSI C 96 the insulation resistance between individual cores and with Sheath and individual cores shall be 100 Mohm at 500 Volts (DC) at 20 ° C.

Shielding for multi-core cables

Over the assembled cores shall be applied a non-metallic binding tape such as Mylar. In intimate contact with this Mylar tape braiding shall be done with tinned copper wire. Colour sheath shall be black and it should be possible to strip the jacket readily without damaging the insulation of the cores

Core identification

Cores of the all the cables shall be colour coded by combination of different colours. OR Bidder To Specify.

Tests and test reports

The manufacturer shall carry out all type tests & routine tests as are necessary to show that the cables offered confirm all respects to the requirement of this specification and all these tests shall be offered at the same laboratory.

Factory test report on (a) Qualification test, (b) All type tests for product sample c) Flammability test d) smoke test e) Oxygen index test for completed cables shall be submitted along with the offer.

Acceptance tests

The following acceptance test shall be carried out on one sample selected at random from each size of the cable in the lot offered The supplier should conduct the tests in the presence of purchasers representative during inspection and tests certificate shall be produced.

- (a) Physical examination and dimensional checks.
- (b) Conductor Resistance Test as per IS: 8130
- (c) Insulation Resistance Test as per IS: 5831
- (d) Thickness of Insulation and sheath as per IS: 5831
- (e) High Voltage Test as per IS: 1554
- (f) Smoke test

10. Specifications of K-Type Thermocouple Extension cable

Standard single twisted pair, flexible thermocouple extension cable suitable to be used with type 'K' Chromel Alumel thermocouples, each conductor PVC insulated, PVC sheathed, overall screened with mylar aluminum tape in contact throughout by a bare copper drain wire is required for Instrumentation and Control.

Standards to be followed

Except as noted the manufacture, testing and packing of cables covered by this specification shall comply with the following standards:

- (1) ANSI C-96.1 : For Conductor wire (K type standard thermocouple conductor)
- (2) IS-5831 : For PVC insulation

General requirement

1. Cables shall be manufactured of such quality that damage will not result from transportation, installation.
2. Cables shall be suitable for laying in conduits, vertical installation, ducts, trenches, trays etc.
3. Cables shall be suitable for contiguous and reliable service at a maximum environment temperature of 60°C.

Conductor

Each core shall be of flexible standard "K" type thermocouple conductors with at least 10 strands of 0.2 mm diameter each (over all area of conductors 0.75 Sq. mm). The composition of the alloys used in the cable shall be as per ANSI C 96.1.

Insulation

Suitable for continuous operation at 60°C. Each core of the extension cable shall be PVC (AS per standard IS-5831). The thickness of the insulation shall not be less than 0.5 mm. The overall sheath of single pair thermocouple extension cable shall be of PVC with thickness not less than 1.2 mm.

Insulation resistance

Insulation resistance shall be 100 MOhms at 500 Volts(DC) at 20 ° C

Shielding

A stranded bare copper wire (overall conductor area 1 sq. mm) shall be available throughout the length of the cable as drain wire for shielding.

Colour coding

The twisted pair of extension cable shall have colour coding as per ANSI C 96.1. The positive polarity wire conductor insulation should be of yellow colour and negative polarity wire conductor insulation should be of red colour.

Overall Diameter of cable

Thermocouple extension cable overall diameter with PVC insulation - to be specified by the bidder.

Tests and test reports

The manufacturer shall carry out all tests as are necessary to show that the cables offered confirm all respects to the requirement of this specification and all these tests shall be offered at the same laboratory.

Factory test report on

- (a) Qualification test,
- (b) Production sampling test,
- (c) Tests on completed cables shall be submitted along with the offer.

The following acceptance test shall be carried out on one sample selected at random from each size of the cable in the lot offered. The supplier should conduct the tests in presence of Purchasers representative.

- (d) Conductor Resistance Test as per IS: 8130
- (e) Insulation Resistance Test as per IS : 5831
- (f) Thickness of Insulation and sheath as per IS : 5831
- (g) Physical inspection of cable

Material certificates

Material certificate from a reputed test lab. shall be provided for correct chemical composition of alloys used for manufacturing the thermocouple compensating wire.

11. Specifications of Fittings

General

The tube fittings should be of good quality, standard Swagelok type, double ferrule and compression type. The fittings shall consist of primarily four components, i.e. body, front ferrule, back ferrule and nuts. The tube fitting shall be made of SS 316 material (as per ASTM A276 & ASME SA479 standards) and ferrules should have hardness better than RB-90. These fittings are required to be used with seamless stainless steel tubes for high pressure and high temperature services as per ASTM-A-213 or ASTM A-269

Service conditions

Process Medium:- Water/ Steam.
Working Pressure:- 250 Kg/Cm²
Working Temperature:- 200 °C

The fittings shall be compatible with the tubes as per standard ASTM-A-213 or ASTM A-269

Pressure rating :- 350 Kg./Cm².

Temperature rating :- 300 °C max..

Type Of Fittings :- Swagelok Double Ferrule compression type tube fittings.

Size and Quantity:- As mentioned at item no. 21 of Table-1 of this document.

Material :- Stainless Steel Tube Fittings made from bar stock (straight configurations) should meet ASTM A276/ ASME SA479 standards and those made from forgings (tees) should meet ASTM A182/ ASME SA182 standards.

Body:- SS 316 as per ASTM-A-276 and ASTM-A-479.

Ferrules:- SS 316L, Tip hardness of back ferrules shall be equal to RB 90.

Nuts:- SS 316 as per ASTM-A-276 and ASTM-A-479. (Nuts for SS fittings shall have silver plated threads to act as a lubricating agent to avoid galling and to reduce tightening torque)

Screw Threads: - All taper threads, NPT as per ANSI-B2-1. Straight threads as per unified screw threads class 2A & 2B or BS Equivalent ANSI-B1-1, or ISO General Purpose metric screw threads as per ISOR-261.

Inspecting & testing

The supplier shall provide either original Swagelok manufacturers test and material certificates i.e certificate of compliance (OR) the following pre-despatch inspection will be carried out at suppliers premises by users authorized representative and shipping release will be issued only after witnessing satisfactory test results.

Dimensional Checks :- The following dimensional checks should be carried out:

- a) Complete checks of threads with applicable gauges or profile projector.
- b) Micrometer check on length and dia and depth of connection not less than one dia of tube.
- c) Complete check of O.D. of fittings and ferrules.
- d) Visual check under magnification of ferrule surfaces, body seats and threads.

Hydrostatic Body Test :- At 1.5 times the body pressure rating.

Hydrostatic Seat Test :- At max. working pressure.

Interchangeability Test :- Identical end fittings shall be fully interchangeable with each other and shall make leak tight joints.

Re-assembly test:- Fittings shall be dismantled and re-assembled at least five times and hydrostatic test shall be repeated.

12. Specifications of Wetleg Pots

3 nos. of wetleg pots are to be fabricated for level measurements. The material shall be SS 316L and size of 50 mm diameter pipe. The length of the wetleg pot shall be 150 mm with 12.7 mm NPT (female) connection at the top, bottom and end side. The top connection shall be plugged.

C. INSTALLATION

The installation and commissioning of all the components given in the Table-1 & 2 shall be done according to the relevant design practices and as directed by concerned engineer. Suitable supports shall be provided for the cables, pipelines, instrument installations. The material in the form of MS sheets, channels, angles, pipes shall be supplied by the contractor for executing the work. The equipment and tools required for executing this job shall be arranged by the contractor. Free electricity will be provided by the department. However, hooking any instruments to the mains power supply, shall be subjected to the necessary approval of the concerned engineer.

1. Installation of differential pressure transmitters on transmitter racks

All the transmitters shall be installed along with their manifolds as per the supplier's procedure. The contractor shall perform the checks required prior to installation of the transmitters and their accessories on transmitter racks/pipes/supports as per the standardized sub-assembly design taking all the precautions given below.

Checks required to be done prior to installation:

The contractor is required to check the following and submit a report in the standard format.

- i) The type, range, tag no., and location of the transmitters tally with that shown in the drawing.

Installation Precautions

The contractor shall ensure that

- i) Stainless steel tubing work and associated tube fittings installations are as per the requirements.
- ii) Operations of 3 valve manifolds and stainless steel isolation valves by plant operators are not obstructed by stainless steel or copper tubes or any other accessories.
- iii) The installation work is such that removal of transmitters, 3-valve manifolds, isolation valves, etc. is easily possible.

2. Installation of Wetleg

Wet legs for level measurements are to be installed. These Condensation Pots are to be installed by means of 12.7 mm NPT (male) to 9.5 mm OD tube connectors. Condensate pots will be provided with tappings for the impulse tubing up to the transmitters, which will be mounted on the respective transmitter racks.

3. Installation of Impulse lines and associated tube fittings

This section covers the requirements for the installation of impulse lines, that convey the process pressure to the relevant instruments and the installation of double ferrule type compression type tube fittings.

4. Installation of impulse lines

The scope of work for the installation contractor is to lay the SS impulse lines from the process tapping to the appropriate DP transmitter. All the tapping points for the measurement of differential pressure have been terminated with 1/4" NPTM. The contractor shall perform the checks required prior to installation mentioned below and also carry out the installation of the impulse lines as per the installation requirements given below.

i. **Bending of tubes:** Cold bending will be done using Hand tube bender which will be provided for carrying out the specified job. The minimum recommended radius for the bending is 3.5 times the outside diameter of the tubes. All the tubes bent shall have a uniform curvature and the surface shall be free from bulges, wrinkles, kinks, flattening, tooling damage and other injurious defects. The use of any filling material during bending is prohibited. Hot bending is not permitted.

ii. **Routing :** The routing of the impulse lines shall be as per the relevant drawings or as directed by the concerned engineer in writing.

Inspection of installations and interconnections

This specification covers the requirements of checks that shall be done on the completed installations and interconnections, in order to verify that these are acceptable as a professional piece of work. These checks are in addition to and no way replace, the checks done by the contractor to satisfy himself that the installation and interconnections are as per the various specifications.

The contractor shall perform the checks mentioned below and submit a report in the standard format.

i) Identification

Establish identity of each impulse line. This includes the tapping point, transmitter/indicator, interconnections etc., in case of differential pressure measurements the impulse lines for high and low pressure tapping points shall be identified and their inter-connections to the proper terminals of the transmitter/indicator shall be checked.

ii) Flow test

Each impulse line shall be tested for its continuity without any obstruction, choke, etc., for free flow by this test. Each impulse line shall be disconnected both at the pipe end and at the instrument end and air shall be passed at about 1 kg/sq. cm or more from one end of the impulse line. Free flow of air at the other end shall be ensured. At the end of the test the connection at the ends of the impulse lines shall be resorted.

iii) Hydrostatic test of impulse line

This test will be made after inspection of impulse line installations and inter-connections as already mentioned in para. Before conducting this test, the contractor shall obtain instruction from the engineer-in-charge as to the instruments/equipment, which are to be disconnected to avoid over ranging.

a) Each one of the impulse lines shall be tested hydrostatically at a maximum pressure of 200 kgf/sq. cm. for 10 minutes with demineralised water at room temperature. There shall not be any damage to the tubing system nor there shall be any leakage from any of the joints.

b) Contractor is required to submit a report in the standard format after testing.

c) All the necessary arrangement including pressure gauge, hand pump, isolating valves etc. will have to be made available by the contractor and same will have to be approved by the engineer-in-charge.

5. Installation of temperature transmitter

Temperature transmitter shall be mounted on rails inside a junction box.

6. Installation of Electrical Junction Boxes and Accessories

The junction box to be used for this facility will be having 100 terminals, suitable openings for cable gland, etc. The contractor shall perform the checks prior to installation mentioned below and also carry out the installation job taking into account all necessary precautions. Installation of accessories, e.g. terminal blocks (100 nos.), cable glands, plug with lock nut and washer to block the cable entry opening of the junction box, shall be done considering the space inside the junction box. The box shall be bolted to the RIG structure with suitable M S work.

7. MS work

Fabrication out of angles, 'C' channels, I beam, GI pipes and painting the fabricated items with zinc silicate and 3 coats of enamel paint by a standard shade of paint as per IS 5. Shade of the paint shall be grey.(the exact shade will be informed later). The paint will be provided as free issue material. All the metal work and metal parts shall be cleaned thoroughly to remove dust, grease, etc. Necessary angle support shall be provided for SS impulse tubing, copper tubing, condensate pots, etc. The M.S. work shall be of good workmanship and free from weld burrs.

Free issue materials

Following (Table 3) are the free issue materials for installation of Process Instruments, associated impulse tubes, valves, tubing jobs and testing the complete process instrumentation system.

Table 3: Free Issue Material

Sl. No.	Description	Unit	QTY.
1	K-type thermocouples	Nos	25
2	Pressure Transducers	Nos	21
3	Accelerometer	Nos	2
4	Strain Gauge	Nos.	3
5	Band Heater	Nos	4
6	Pressure gauge	Nos.	1
7	Magnetic flow meter	Nos.	1

D. CABLING AND WIRING

All the cables are to be properly laid through the cable route as decided by the concerned engineer. Wherever required suitable cable trays shall be provided for laying the cables. Proper dressing, tying and identification shall be done wherever required. The entire cable laying procedure shall be subject to the approval of our concerned engineer. All the wires shall be terminated. The lugs and ferrules are to be supplied by the contractor within the quoted cost for termination. These items shall also be subjected to the approval of our concerned engineer. Prior to cable termination, necessary end preparation etc. shall be done. The required necessary soldering shall also be done. Wiring diagram, cable schedule and other installation details will be provided at the time of installation.

1. Laying of multi-core cables

The contractor's scope of work is to lay the multi-core cables on the cable trays and to

terminate the cables on junction box with proper cable glands. The routing will be decided in consultation with concerned engineer. All rubber bushes, lock nuts, inspection crosses, clamps, saddles, spacers, screws, nuts, washers, and other accessories shall be supplied by the contractor as required. All these items are subject to approval by the engineer. No PVC/plastic material for the above items other than bushes will be accepted. The contractor shall carry out the checks listed below prior to installation and follow the installation requirements given below.

Checks to be done prior to installation

The contractor is required to check the following and report in the standard format. The size and routing of the cable tallies with that shown in the sketch/drawing.

Installation requirements

The contractor shall ensure that the following requirements are met while installing the cables.

1. All the cables shall be run parallel with existing structural members in a neat and orderly fashion. Cables entering junction box shall be brought up securely and perpendicular to the box surface. Welding or brazing of the cables will not be permitted.
2. If an instrument power supply cable is run, then a continuous run of 10 SWG copper conductor for earthing shall be provided by the contractor for the conduit run and clamped at suitable intervals.
3. Proper supports like hangers, clips, clamps, saddles, etc., shall be used at regular intervals of not more than 1.0 meter so that the cables are firmly fixed to structures, walls, ceilings, floors, etc.
4. Exposed cable near the equipment (like pumps tanks) shall be adequately supported by clamps or straps or by other approved methods.
5. No welding will be permitted on the structural beams.

Pulling of cables

Each cable/wire shall be pulled as directed by the engineer. All the cables/wires shall be neatly trimmed without interlocking. Care should be taken by the contractor to avoid sharp bending and kinking of conductor, damaging insulation and stressing the cable beyond the pulling force recommended by the manufacturer. Cables shall be protected at all times from mechanical injury. Cable ends shall be suitably sealed to prevent ingress of moisture as required. The attachment used for pulling the cables shall be cable grips or other devices approved by the engineer. In case undue difficulty in pulling is experienced, the contractor shall check the pulling force required and suspend further pulling, until the procedure to be adopted for pulling is approved by the engineer. Oil or grease shall not be used for lubrication in pulling the cables, but where necessary French chalk of approved type may be used for pulling cables.

2. Electrical wiring

All the wires are to be connected with the help of crimping type lugs for signal of the individual component terminals. Lugs, identification ferrules, PVC sleeves etc. are in the scope of contractor's supply. For making soldered connections (without identification ferrules) following procedure must be followed:

a) Preparation of conductors and terminals

Strip sufficient insulation from the wire or leads, so that no insulation touches the solder connection. In stripping insulation, care should be taken to avoid nicking or otherwise damaging the wire or the remaining insulation. Use of high tool or thermal stripper for stripping the insulator is allowed.

b) Cleaning of conductors and terminals

Conductor surfaces to be soldered should be cleaned prior to the soldering as follows:

* Grease and oil should be removed from the conductors and terminals by applying Isopropyl alcohol and drying with a hair dryer.

* Oxides and varnishes should be removed without damaging the leads or parts with the help of fine emery cloth.

* Dust or loose matter should then be removed.

c) Pre-tinning (Pre-solder coating) conductors and terminals

All the conductors and terminals should be given a pre-solder coating prior to their joining, however care should be taken during pre-tinning of a stranded wire to see that the pre-solder coating does not cover the wire contour at the termination and of insulation and thereby permits inspection of wire for damage. Heat sinks should be applied to leads of heat sensitive parts during the tinning operation. Use nose pliers to hold the lead of a heat sensitive part near the joint can effectively serve the purpose of a heat sink. Wicking the capillary flow of solder along the wire - is permitted, however, solder should not cover the contour of the conductor at the termination of the insulation.

3. Inspection of cable installation and interconnections

The contractor shall perform the checks mentioned below and submit a report in the standard format

Identification

Establish identity of each signal cable. This includes the instrument, junction box, interconnections, etc.

Insulation

Signal cables shall be tested for insulation between cores and to earth to check with compliance with the minimum value specified.

Continuity

Each core in each cable shall be tested for continuity.

Continuity of shielding wire

In the case of multicore cables, the continuity of the shielding wire and the continuity of the communication wires shall also be checked.

E. TESTING AND COMMISSIONING

The testing and commissioning of all the components given in the Table-1&2 shall be done according to the relevant practices and as directed by concerned engineer.

F. WORK QUALITY:

All work shall be done with good workmanship. Our supervisor will supervise quality of work.

G. SECURITY PERMISSION:

Contractor shall appoint the required workers with high integrity and will be responsible for his workers. All BARC/IGCAR/AERB security rules will be applicable. Supplier must dispose off all the debris after completions of the job. Entry permit will be issued on monthly basis and contractor must have valid photo pass up to March, 2018.

H. WORK PERIOD:

After the supply of firm work order, the work shall be completed in 90 working days.

I. PRICE SCHEDULE

The bidder shall quote unit rates for each item of work given in Table-1&2 for supply of items, installation, testing and commissioning work. The amount for each item shall be worked out and the requisite total shall be given. NOT GIVING THIS BREAK-UP TO THE FULLEST DETAIL AS REQUIRED IN THE TABLE SHALL BE SUFFICIENT CAUSE FOR OUTRIGHT REJECTION OF THE OFFER WITHOUT ANY CONSIDERATION.

J. COMPLETION OF CONTRACT

The works to be executed by the contractor shall be deemed to be completed only when

- i) The supply, installation, testing and commissioning are carried out as per the technical requirements given in this tender document and
- ii) Any defects, deficiencies brought out during testing are rectified and retested wherever necessary to the satisfaction of the engineer.

K. GENERAL SPECIFICATIONS:

1. Quality surveillance, inspection:
All work covered by the specification shall be subject to quality surveillance / inspection by our authorized representative.
2. No insurance policy is required for free issue material as the job is done in house.
3. The vendor shall not sub-contract any or all of the work without written consent from the purchaser. The vendor shall be responsible to the purchaser for all work of the sub-contractor, if allowed.
4. Payment will be made only after satisfactory completion of the work and against submission of original bill and advanced stamp receipt
5. Income tax of 2% on the bill amount and surcharge as applicable shall be deducted from the payment.

L. GUARANTEE CLAUSE

The contractor should give guarantee of one year from the completion of the job, for the material quality and workmanship. The certificate regarding to the same has to be submitted by the contractor after completion of the job.

M. GST CLAUSE

The quotation shall be on proper letter head mentioning complete address, Phone numbers, fax number, PAN number/ GST registration, etc. Without these details quotation will be liable for rejection.

Annexure -II

1. **Confidentiality:** No party shall disclose any information to any third party concerning the matters under this contract generally. In particular, any information identified as “**Proprietary**” in nature by the disclosing party shall be kept strictly confidential by the receiving party and shall not be disclosed to any third party without the prior written consent of the original disclosing party. This clause shall also apply to the sub-contractors’ consultants, advisers or the employees engaged by a party with equal force.

2. **“Restricted information” categories under Section 18 of the Atomic Energy Act. 1962 and “Official Secrets” under Section 5 of the Official Secrets Act. 1923: -**
Any contravention of the above-mentioned provisions by any contractor, Sub-contractor, consultant, adviser or the employees of a contractor will invite penal consequences under the aforesaid legislation.

3. **Prohibition against use of BARC’s name without permission for publicity purposes:**
The contractor or sub-contractor, consultant, adviser or the employees engaged by the contractor shall not use BARC’s name for any publicity purpose through any public media like press, Radio, T.V. or Internet without the prior written approval of BARC.